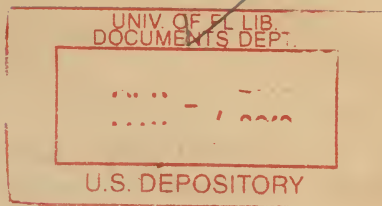


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# Hawaii Agricultural Experiment Station, HONOLULU.

E. V. WILCOX, SPECIAL AGENT IN CHARGE.

PRESS BULLETIN NO. 21.

## Fruit Marketing Investigations in 1907.

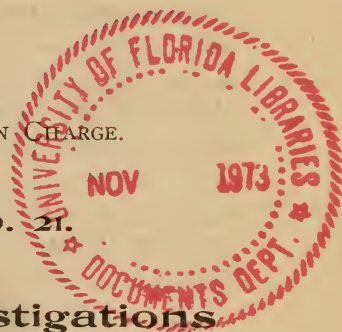
By J. E. HIGGINS,

Horticulturist, Hawaii Experiment Station, United States Department of Agriculture.

### INTRODUCTION.

Fruit production is destined to become one of Hawaii's most important industries. Already pineapple growing has assumed very considerable proportions, and there are today between two thousand and three thousand acres under successful pineapple cultivation, where a few years ago the land was thought unfit for any purpose other than grazing. The pineapple area is rapidly increasing and conservative men believe that the industry is as yet in its infancy.

Other fruits, it is believed, will repeat the history of the pineapple in Hawaii. Together with the soil and moisture requirements, the absolute freedom from frost renders this group of islands peculiarly adapted to the growth of tropical and sub-



tropical fruits. Some of these fruits such as the avocado, the mango and the papaia in their present state of semi-cultivation or absolute neglect give great promise of results under the new horticulture which is beginning in Hawaii.

To ascertain the best methods of marketing, including every step in the process from the gathering of the fruit in the field, to its sale in the market, is quite as important in any fruit industry as the knowledge of production. To determine some of the important factors in marketing Hawaiian fruits, the Hawaii Experiment Station has undertaken a series of experiments which have now covered about four years. The report of this work to the close of the season of 1906 has been published in Bulletin No. 14. This paper presents the results of experiments and observations in 1907 so far as they are of immediate practical application.

On July 24 there was shipped from Honolulu to San Francisco a consignment of about 12 tons of pineapples, 1300 avocados and 200 papaias. These were under the direction of the horticulturist of the Station, who personally accompanied the shipment. A part of the pineapples were trans-shipped by water to Los Angeles. There and in San Francisco careful examination was made of the fruits in each crate, although in Los Angeles it was not possible to personally supervise the work.

Cable advices regarding the results of different methods of handling and packing were forwarded to the experiment station, and preparations were made for a shipment to Chicago of a car load of pineapples and avocados. The date of sailing was August 14 and that of arrival in San Francisco, August 21. This fruit was examined and such of the pineapples as appeared to be in condition for trans-shipment, were sorted, repacked, placed in a refrigerated car and forwarded to Chicago, by way of Ogden leaving August 22, and arriving in Chicago, August 31. All the avocados were placed in the car without repacking. The car was pre-iced on the afternoon of August 21. September 1, being Sunday, and September 2 falling on Labor Day, it was not possible to remove the fruit from the car until September 3. On the third day a careful examination was made of the

avocados and pineapples. The avocados were in good condition for immediate consumption, but were not so firm as they should be for the market. Had they been perfectly hard when taken from the steamer, it is believed they would have arrived in the same condition in Chicago.

The pineapples opened up in most excellent condition. The loss was less than one per cent. It was reported that some of the fruits showed more or less discoloration in ripening. This, however, has been noticed repeatedly on fruits shipped with refrigeration and without to San Francisco and other points. The outcome of this trial shipment by rail strongly suggests that it will be no more difficult to place Hawaiian pineapples in the interior markets than in the markets of the Pacific Coast.

## GENERAL.

For convenience and to avoid needless repetition, subjects relating to transportation, markets and organization for marketing purposes, may be discussed in general.

## TRANSPORTATION.

BY LAND. Until the present time there has been practically no freight transportation of Hawaiian fruits by rail. A few express shipments have been sent to inland cities, and by water freight Hawaiian pineapples have reached the chief markets on the Pacific Coast. One of the obstacles in the way of shipments by rail has been the high freight tariff. The railroads subject to the Inter-State Commerce Commission have made a tariff schedule on "deciduous fruits," and other tariffs on citrus fruits. Though the term "deciduous fruits" is of rather loose application, Hawaiian pineapples and many other tropical fruits could not well be classified here. In preparation, therefore, for the experimental shipment by rail to Chicago, this subject of freight rates on tropical fruits was taken up with the railroads. Permission was received by them from the Inter-State Commerce Commission to announce a regular tariff on "tropical fruits,"

identical with that for "deciduous fruits." The tariff sheet now reads, "Rates on Deciduous and Tropical Fruits."

These rates are as follows:

TO	In Carloads of not less than 24,000 lbs. PER 100 LBS.
Colorado Common Points.....	\$ 1.15
Missouri River Common and intermediate points and points west thereof to which Missouri River Common and intermediate rates are authorized to apply .....	1.15
Mississippi River Common Points.....	1.15
Chicago and Common Points.....	1.15
Cincinnati, Detroit and Common Points .....	1.40
Pittsburg, Buffalo and Common Points, including points in Canada taking Toronto rates, as shown on pages 10 to 21 of the tariff ....	1.40
New York, Philadelphia, Baltimore, and Common Points, } including points in Canada taking Montreal rates as shown on pages 10 to 21 of the tariff .....	1.45
Boston and Common Points, including points in Canada } taking Sherbrooke rates, as shown on pages 10 to 21 of the tariff.....	1.45

This practically opens the way for carload trans-continental shipments. Hawaii can now take advantage of all the facilities for shipment offered to the fruit growers of California. These facilities, which have been gained by the California shippers, through long and strenuous experiences, are practically the free gift to the shippers from Hawaii. During the whole of the fruit season special fruit trains leave daily for Eastern points. These are hastened through to destinations as rapidly as possible, the time required from San Francisco to Chicago being scheduled at eight days. Cars are kept iced throughout their journey and the shipper is permitted to give his own instructions regarding the opening or closing of the ventilators. The railroads issue a sheet for the convenience of the shipper which is as follows:

## REQUEST TO VENTILATE PERISHABLE FREIGHT.

.....190..

To Agent,

.....

.....

We have this day delivered to you for transportation the following perishable freight .....

.....

Car number .....

Initial .....

Destination .....

Consignee .....

Keep ventilators open to destination.....

Keep ventilators open to.....

Keep ventilators closed to destination.....

Close ventilators at .....

Open side doors for ventilation at.....

It is understood as between shipper and carrier that the carrier undertakes to comply with above request only as accommodation to and in the interest of shipper, and in so doing does not assume any risk for loss or damage to said property.

.....Shipper.

Note:—In absence of specific instructions by shipper as to opening and closing ventilators, the carriers will **exercise their judgment**, at owners risk, and for information of railway employes only, **way-bills will be stamped:**

“Put in ice plugs and close hatches when temperature falls below freezing. Open hatches and take out ice plugs immediately when temperature is above freezing.”



**MANNER OF PACKING THE CAR.** It is important that a car should be properly packed in order to permit of the free circulation of air among the crates and, at the same time, to prevent shifting. In so long a haul with many stops and sudden jerks in switching, if the crates are not held firmly in position they would rapidly be broken and the fruit injured. Different methods of packing a car are in vogue with different kinds of fruits and different types of crates. Orange boxes for example, are usually stood on end and the dimensions are such that a given number will exactly occupy the floor space of the car. With other fruits such as grapes, the crates for which are flat, there is usually an open space in the center of the car where the crates must be braced to hold them in position. Circulation of air among the crates is provided for by placing small strips on the floor of the car and beneath each tier. There is also a large open space running lengthwise of the car, between each two rows of crates. Were it not for this arrangement it would be practically impossible to get the fruit in the center of the car refrigerated. What method of packing pineapple crates in a car will prove best is a matter which must yet be worked out, and will probably depend in part upon what type of crate is adopted. From the limited experience afforded by a single car, it would seem that the large sized crate in most common use in Hawaii should be placed on edge. A car would probably hold about 160 crates, which would represent about 24,000 lbs. or the minimum carload. This would be without overloading the car by placing the fruit too high. It is always customary to leave a large open space at the top, on an average perhaps about  $\frac{1}{4}$  of the height of the car. The warm air rises to the highest point, and therefore fruit that occupies a position near the top of the car would receive very poor refrigeration. This arrangement of the crates allows for four rows on the floor with an air space next to the walls of the car and between the rows.

**COST OF TRANSPORTATION.** The expense involved in moving a carload of pineapples from the wharf in San Francisco to Chi-

cago, including the cost of repacking, would be approximately as follows :

Freight .....	\$ 276.00
Loading .....	1.50
Repacking at 20 cents per crate .....	32.00
Cartage, wharf to car .....	16.00
Icing charges .....	85.00
<hr/>	
Total .....	\$ 410.50

Taking the weight of a large crate of pineapples packed, as 150 pounds, which is believed to be about an average, approximately 78 per cent of the total weight would be fruit, and 22 per cent tare. In a 12 ton car there would be about 9.36 tons of fruit. The cost of moving a ton of *fruit* from the San Francisco wharf to Chicago would be, according to these figures, about \$44.00. Figured per crate, the cost would be about \$2.55.

TRANSPORTATION BY SEA. REFRIGERATION. There are two distinct methods of transportation, by ocean freight, the one involving refrigeration, the other ventilation. Such fruits as avocados, mangoes, and papaia demand refrigeration, while the pineapple may be shipped without it, and its use is not at all adapted to the banana. Although the volume of freight demanding refrigeration at the present time is very small, there can be no question that it will increase and that the shipment of refrigerated fruit will become an important industry. In the interests of those who are already shipping this class of perishable goods, and also in the interests of future development, it is opportune to give attention to the requirement of refrigeration in ocean transit.

The exact temperatures which are best adapted to the preservation of each species of tropical fruit has not yet been determined. This in itself is a line of work which would involve extended experiments and which cannot be carried out without larger expense than the Station has been able to afford. It has been found, however, that avocados and papaias are not injured by a temperature of about 40 degrees F., continued for several

weeks. On the other hand, it has been found that holding the temperature of the refrigerated compartment at 50 degrees F., has resulted in the ripening of the fruit. Tentatively, therefore, it is recommended that steamships carrying avocados and papaias should hold the temperature between 40 and 45 degrees.

STEVENING THE FRUIT TO PERMIT REFRIGERATION. It is important in stowing the crates to place them so that there can be a free circulation of air between and also beneath them. Some adaptation of the methods adopted in packing cars, as described above, should be followed by the steamship companies in their refrigerated compartments. It is almost impossible to refrigerate a solid and compact mass; and it is only by causing the cold air to pass to every part of the compartment that the fruit can be brought down to a low temperature. The temperature indicated by the thermometer within the compartment may be no index to the temperature of the fruit in the crates. It has been found in trans-continental shipments made for experimental purposes by the Division of Pomology of the U. S. Department of Agriculture, that even with the best arrangement of packages within the car, and with ample supplies of ice the temperature of the fruit in the center of an orange box remains for several days far above that of the atmospheric temperature within the car. After a compartment on steamship is filled with fruit it will require considerable time to get the temperature of the room to 40 degrees, and it must then be distinctly borne in mind that the fruit will be much later in assuming this temperature, even with the best methods of steving. With no care being taken to permit free circulation, the fruit farthest from the pipes and in the center of the crates may spoil before its heat has been removed. For these reasons it is eminently important that the engines should be working and the room brought to a low temperature before being opened to receive the cargo, and that it should remain open the shortest possible time. When the cargo is in place the doors should be opened as little as possible, should never be allowed to remain open, and every effort should be made to hold the temperature at a uniform degree.



Every steamship attempting to carry refrigerated tropical fruits should observe these general principles. Furthermore, every steamship which is expected to develop the fresh fruit industries of Hawaii should be equipped with at least a small compartment which can be used for the carrying of such fruits as require low temperatures for their preservation. Only in this way can these smaller industries be developed, for no one will plant and cultivate fruits with no means of getting them to market.

SHIPPING UNDER VENTILATION. The greatest present need in Hawaiian fruit transportation is ventilation. The results recorded in Bulletin No. 14 of this Station have been confirmed by the experiences of the past summer. The requirements as set forth therein for the shipment of fruit without refrigeration were as follows: First, ventilation; second, dryness; third, reasonably low temperatures; fourth, careful handling and steving. Few if any steamships at present in the trade can assure the shipper that his fruit will receive these requirements of safe shipping. Pineapples and bananas have been carried on deck on some of the steamers, covered with an awning and with tarpaulin on the sides. Strips of board placed beneath the crates, permit of ventilation beneath. By this means, in favorable weather, both bananas and pineapples arrive at their destination in good condition. In heavy storms it is not easy to keep the fruit dry. In cold weather fruit cannot be shipped in safety on deck. The ventilation supplied to the compartments below deck is insufficient unless some method of mechanically forced draught is adopted. The windsail when it can be used serves a valuable purpose, but its use is subject to the uncertainties of weather. There is no one factor that the development of the fresh pineapple shipping industry depends upon so much as this matter of properly equipped steamships for the trade. The fruit is already growing, is being put in the cans at a much lower value than could be realized on fresh fruit shipments, the markets are asking for the fruit and the railroads offer means of transportation after it has once reached the mainland. Provided with suitable

ships, the export trade in fresh pineapples would well repay the cost incurred in equipment.

From the standpoint of the fresh fruit shipper it is far more important that ships should be regular and frequent, than that they should be large. If local capital is to own or control ships which will carry this class of fruit, it must be remembered that one large ship though it may or may not be better from the standpoint of passenger traffic, will certainly not meet the needs of fresh fruit shipping. Fruit that is too immature for shipping today may be too ripe two weeks hence. The boats should run as frequently as once in ten days at least, and with regularity. If the shipper cannot know, within a few hours, the time of sailing, he may either have his fruit stand in the heat awaiting the departure of the ship, or it may be too late to be taken on board.

CAREFUL HANDLING of the fruit whenever it is moved is of great importance. The steamship handles the fruit in loading and unloading. The method adopted in unloading, whereby the crates are allowed to slide down a chute, is capable of doing much damage. This is a convenient and easy method of unloading, but with the average man at the foot of the chute, every crate stops with a sudden jerk bruising many of the fruits within. It might be possible to arrange a chute so that the crate would slowly stop, but in actual practice, it is an exception, so far as the writer's observation goes, that a crate is stopped without a sudden jar. In loading, if the crates are taken on board in a sling, a frame should be arranged so that the ropes will not bind against the outer crates and bruise the fruits within. It is a common practice in carrying crates to allow them to fall two or three inches when setting them down. This is true not only at the steamer but among all those who handle the crates. The practice must be avoided or bruising will certainly follow.

#### ORGANIZATION FOR MARKETING.

. Of equal importance with transportation facilities, is the organization of the growers and shippers into a co-operative marketing concern. The success of co-operative marketing elsewhere

and the failure of other methods which has been amply demonstrated in Hawaii, should be sufficient argument to lead all those interested in marketing fresh fruits to cooperate in a marketing organization. In fact, no large fresh fruit trade is likely to be built up except through some strong central organization of the shippers, or the formation of an independent marketing company who will buy the fruit for shipment. The latter will be the result if the growers fail to organize themselves. Such a company will buy the fruit at canning prices and ship them as green fruit, and thus the profits of fresh fruit marketing will pass from the grower. The need of organization has been set forth already in Bulletin No. 14 of this Station, and it is only necessary to say here that the observations of the more recent study of the markets has strengthened the conclusions presented therein.

The marketing organization should be represented in Honolulu and all points in the Territory from which direct shipments are made. It is also equally important that at least one man should represent the shippers in San Francisco, and the business would certainly demand in the near future that other representatives be placed in the different markets to be reached. Every agent should be on salary, with no commissions, and should not engage in the selling of other fruit. There should be a man in San Francisco to look after the interests of Hawaiian shippers, to receive, care for, and trans-ship fruit. This is all the more true since much of the fruit would be better for repacking before trans-shipment.

The local agent at the shipping point should receive the fruit, should see that it is handled with utmost care by the transfer and steamship companies, while the agent at San Francisco or other port, should be present to receive the fruit and see that every handling is performed with care.

Whether the fruit is to be sold at private sale, or at public auction, must be determined by the shippers. In part it may be necessary to follow the precedent of each market, but in any case, the consignment and commission system should be avoided. In some markets, fruit is sold through brokers at private sale. In others, there is a public auction at which all buyers may bid.

First class fruit usually brings a better price through private sale, provided the agent is a good salesman. In Chicago, where the experimental shipment of the past summer was marketed, Florida pineapples are sold at private sale.

## MARKETS.

THE MARKETS THAT MAY BE REACHED. In Bulletin No. 14, it was stated that in the future development of the tropical fruit trade, the Eastern cities of the United States would probably be supplied by Porto Rico, Florida and Cuba, while the western coast could be supplied from Hawaii. Although it would not be wise to draw too general conclusions from a single experiment, it must be said that the results of the shipping investigations of the past summer point towards a much larger outlook for Hawaiian fruit marketing. The pineapples and avocados which were taken to Chicago in August, 1907 arrived in such condition as to justify the belief that these two fruits could be distributed over a much wider area than had been previously hoped. A leading dealer in fruits in Chicago representing a firm which ships fruit to Europe, as well as to all parts of America, on examining the pineapples, stated that, from a business point of view, if the carload were the property of his company it should be trans-shipped at once to New York; and further, that fruit in such condition could be shipped to any of the world's great markets. If future experiments of this kind shall confirm the results of the past season, it will be conservative to say that Hawaiian pineapples may be shipped to any part of the United States or Canada. It is possible that some kinds of fruits may not stand the distant shipment, and for these, markets must be developed nearer home. For example, the papaya will probably not endure a long journey by rail after reaching the mainland. The avocado travels much better, and with proper refrigeration and handling, can probably be carried far inland. This is true also of the mango. The carrying qualities of some other fresh fruits which have not been marketed on the mainland, have yet to be determined.



THE CAPACITY OF THE MARKETS for tropical fruits, when once developed, can be judged by the enormous consumption of other fruits, which, a few years ago, were comparatively unknown, or were not shipped in quantity to eastern markets. To illustrate this, it may be said that more than twenty carloads of California grapes are sometimes sold in a single morning in the Chicago market. It is estimated by those most familiar with the fruit trade of Chicago that this market receives at present about twenty-five hundred carloads of pineapples per year. The present consumption of this fruit is only the faintest indication of the amount which will be consumed in the future provided proper methods for developing markets are pursued. This presupposes a marketing organization. Through such an agency a constant supply of fruit can be kept upon the markets during the season. By this means also, the over-stocking of one market while another is bare will be avoided, and by care in repacking on the part of the trans-shipping agent, fruit of uniformly first class quality can be supplied. This constant stream of good fruit flowing into the markets will rapidly increase their capacity. In Ogden, Salt Lake City and Denver it was found that there were dealers ready to receive Hawaiian pineapples in carload lots. With the exception of Reno, Nevada, these were the only markets visited between San Francisco and Chicago. No doubt all the large cities would take the fruit in freight lots.

Developing the fresh pineapple market means an enormous increase in the use of canned pines. The canned product on the shelves of the grocery store attracts little attention, a pineapple tin appearing the same as that containing any other fruit. On the other hand the fresh fruit is conspicuous by its unusual form and beauty, and if of good size, attracts the attention of every passerby. If reasonable in price, he buys and perhaps learns for the first time the taste of the pineapple; or if he has eaten the pineapple before, he learns for the first time the quality of the Hawaiian product. Later when the fruit is out of season he buys it in the can. If Hawaiian growers fear an over-production of pineapples, the best possible policy would be to keep

selling the fresh fruit in as large quantities as the markets will consume.

The term "overproduction" merely expresses a relation in which the immediate supply exceeds the demand. Equilibrium may be restored not through any permanent reduction in the supply, but through increase in demand. This may be accomplished through more general distribution. As an illustration of this, there are more prunes and raisins sold today at remunerative prices than were grown at any time during the period of so-called over-production in California and Oregon. The rational move for the growers of pineapples is to organize their efforts to keep the demand constantly in advance of the supply.

In the discussion of markets the pineapple is spoken of in particular since that fruit is grown most extensively in Hawaii. There are those who are making a specialty of handling rare fruits and particularly tropical fruits in the great markets but this is comparatively a new business.

COMPETITION. It is not to be expected that Hawaii can have the whole field without competition, nor is it necessary. Some have thought that Hawaiian pineapples could not compete in price with the Florida product. The prices of the latter, as quoted in the Eastern markets, are somewhat misleading to the Hawaiian grower. Prices are usually quoted per crate. The Florida crate being much smaller than the Hawaiian, and the fruit also being of much smaller size, the comparison of prices means very little, except when brought to a per pound basis.

The quotations in Chicago on May 22, 1907 were about as follows:

42 size	.....\$2.75	per crate
36 size	..... 3.25	per crate
30 size	..... 3.50	per crate
24 size	..... 3.50	per crate
18 size	..... 3.50	per crate

The "42 size" indicates that there are 42 pines per crate. The gross weight of a crate is about 75 pounds, and the net weight

approximately, 60 pounds. It varies little with the size of the fruit. Therefore, about 60 pounds of fruit were selling on that day at \$2.75 to \$3.50 according to size of fruit. The finest of these, the eighteens, would average only 3.3 pounds per fruit, or smaller than any fruit which is shipped from Hawaii. The price of the best grade would be about the equivalent of \$116 per ton. If this price were received for Hawaiian pines, there would be left a very considerable margin after deducting the costs of transportation. Hawaiian pines sold in September in Chicago for \$155 per ton.

Although the Florida crop matures about the same time as that of Hawaii, when the Hawaiian pines were sold in Chicago in September, the market was bare of other pineapples and was reported to have been so for a long time. The dealers stated that very few pines were received during the summer and the Hawaiian product would find a ready sale.

The Florida output consists of about half a million crates per year. This, however, is subject to the uncertainties of weather to a greater degree than the Hawaiian crop. For example, the Florida crop for 1907, especially on the lower east coast, suffered seriously from a freeze and the entire pineapple area was visited by a severe drought. It is estimated that these two factors reduced the crop to about 40 to 60 per cent of the normal. Although the Hawaiian pineapple fields may at some future time suffer from severe drought, frost is unknown. The assurance of protection against this dread enemy which those in an "almost" frostless country are constantly in fear of should quite offset the difference in the cost of transportation.

Comparing the quality of the fruit, it has been recognized in all the markets visited during the past summer's investigations, that the quality of the Hawaiian pines as to flavor, texture and juiciness is far superior to the average. This may perhaps be attributed in part to soil and climate, but is probably due in a large degree to the variety which is grown in Hawaii most extensively. The "Smooth Cayenne" is recognized as a pineapple of fine quality, but Hawaii must not be blind to the fact that her competitors

have chosen the "Red Spanish" because of its better shipping qualities. About 90 per cent of the Florida crop is said to be of this variety. If, however, the Smooth Cayenne can be successfully shipped with only a small loss in transit, it will out-sell the Red Spanish.

It has also been supposed by some that Hawaii has a peculiar obstacle to contend with in the black rot of the pineapple. This, however, is incorrect since the same disease has been reported in pineapples which have been received in the Chicago markets from southeastern points. This disease is more prevalent in the Smooth Cayenne variety than in the Red Spanish.

## PINEAPPLES.

### SPECIAL CONDITIONS AFFECTING SUCCESS IN SHIPPING.

CARE IN HANDLING. The pineapple, as grown in Hawaii, is an unusually delicate fruit to ship. Its weight is the first factor in the problem. If an apple, a peach or an orange falls an eighth or a quarter of an inch, there is comparatively little momentum overcome when it strikes on a single point. When, however, a five to nine pound pineapple falls the same distance and comes to rest on a comparatively small portion of its surface, or when in sliding down a chute within a crate, it suddenly comes to rest against an adjoining fruit, the momentum causes bruising, or a destruction of the delicate cells within the fruit. In the case of a cured orange, or pomelo and in many other commercial fruits, there is a certain elasticity which tends to overcome bruising, and to protect the cell structure within. This is lacking in the pineapple. Further, the composite character of the pineapple is against it as a shipping fruit. It is really made up of many small fruits, or segments, placed closely together but easily separable from each other. A bruise which would not be sufficient to rupture the epidermis of most commercial fruits, would be sufficient to cause a separation between two of these segments, thus affording an opening for the exudation of juice. This provides the best possible medium for the growth of fungi.



The abundance of the juice in itself is another contributing factor.

It, therefore, becomes extremely important that the pineapple should be handled with utmost care. A large portion of the losses, which were observable in the fruits used in the experiments were plainly due to bruising. This care must be exercised at every step from the gathering in the field to delivery in the market. The grower, the shipper, the transfer companies, the steamship companies, and the fruit dealers each have their part to perform, and neglect or carelessness at any point in transit will result in loss to the owners of the fruit. It should never be thrown or allowed to fall even the slightest distance, nor be carried from the field to the packing house in bulk. The packing of a ton or more of pineapples loose on a wagon must result in the bruising of a good many fruits. In fact, it would probably pay to allow each pineapple to sustain no other weight than its own from field to packing house, where it has no protective material surrounding it. This could be accomplished by single layer crates. Only spring wagons should be used.

Under present methods of shipping, the packer should use liberal amounts of packing materials. In the experiments of 1906 it was found that the crates shipped with very little packing other than a paper wrapping, went through with very small loss. In the 1906 shipment, however, the fruit was more carefully supervised at every handling than was possible with the shipments of the season of 1907, or would be possible with commercial shipments except through a marketing organization. If all the fruit were handled by its owners, the use of very little packing material might be recommended. The transfer companies carrying the fruit from railroad to wharf should be cautioned in regard to the handling of delicate fruits. It is much easier to drop a crate, allowing it to fall an inch or two, than it is to place it where it belongs. Men who are accustomed to handling packages constantly, naturally acquire the easiest method.

The duty of the steamship companies, in relation to careful handling, is the same in part as that of the transfer companies.

The methods of loading and discharging the cargo, can be much improved upon. Pineapples are frequently taken on board by means of a sling which bruises the fruits where the rope binds the crate. In discharging the fruit even greater damage occurs when the chute is used. The crates are placed at the top of an inclined plane and are allowed to descend, by their own weight. In practice, nearly every crate comes to a sudden stop on the level plane at the foot of the chute with consequent bruising to the fruits within. It is difficult, if not impossible, for a man at the foot of the chute to control the matter so that the crates will come to rest slowly without jar. Some device must be sought which will obviate this bruising both in taking on and discharging the cargo. Where the fruit is hoisted by tackle attached to the boom, or freight crane, it would be possible to avoid the bruising by the rope if a frame were made in which the crates could be placed, so that the binding would be against the frame instead of the crates. This injury can be largely avoided by the use of strips of wood at the four corners of the sling to distribute the pressure. A more rapid method of loading and discharging, if there were sufficient business to justify it, would be an adaptation of the endless chain carrier with attendants at the top and bottom. By this means, the fruit could be handled much more rapidly and with less injury. Perhaps the present shipments of fresh pineapples would not justify any steamship company in putting in this apparatus for pineapples alone. If, however, there were a fresh fruit marketing organization, and a larger quantity shipped, this would appear to be the most satisfactory method of handling the crates at the ship. It may be said also that this method would be equally advantageous in the case of bananas wherever they are not trucked into the ship.

The responsibility of the commission merchant for the handling of fruit begins at the dock. The most satisfactory method of securing uniform care from this point to the retail dealer is in having the ownership pass from the grower to the wholesale dealer. It is useless to expect the average commission mer-

chant to take the same care with consigned fruit that would be taken with fruit which he owns. As an illustration of this, it may be said the writer has seen Hawaiian bananas thrown fully ten feet and allowed to drop on the bottom of a wagon and then piled ten or twelve feet high, the loader standing on the lower tiers while the upper ones were being placed. No man would treat his own bananas in this way, nor is it intended to intimate that every commission house so treats fruit consigned to it. But how is the consignor to know what injury is the result of careless handling on the part of the consignee? It is even more important that the pineapples be handled with care at their destination than in the field, since they are riper. The chute is in use in many commission houses also as a means of transferring the fruit from the wagon to the basement of the fruit house. Although the distance is not so great as from the steamer's side to the wharf, the momentum acquired before the floor of the basement is reached, is sufficient to cause much bruising unless the operator at the foot of the chute is on the alert to prevent sudden jar. It is important also that the pineapples which have traveled 2,000 miles by steamer, should be picked over as soon as possible eliminating those which are decaying, and thus avoiding the spread of disease.

PACKING MATERIALS. Further tests were made of the relative value of hay and excelsior for packing pineapples in the crates. So far as the preservation of the fruit is concerned there appears to be no difference but the excelsior makes a better appearance. Corrugated strawboard was also tested as a wrapping about each pineapple but with no added benefit.

PINEAPPLE ROT, *Thielaviopsis ethacetica*. The presence of this disease in pineapples was mentioned in Bulletin No. 14. As stated above, this disease is not peculiar to Hawaii. It, nevertheless, appears to be an important factor in the problem of fresh fruit shipments, and its control is a matter of great importance. Every means possible should be taken to avoid infection with the spores of *Thielaviopsis*. Even should it prove practicable to arrest the development of the fungus in pineapples before

shipment, the importance of avoiding infection remains the same. In most fungus attacks upon ripening fruit, a large part of the injury results from increasing the number of vulnerable points. In the case of citrus fruits for example, it has been found <sup>1</sup> that much of the heavy loss sustained has been due to abrasions of the rind caused by brushing, or by the orange clippers, or from other sources. Although the exact life-history of *Thielaviopsis* in pineapples has not been thoroughly worked out, it is reasonable to suspect by analogy, some of the probable means of infection. First, infection may readily take place through the moistened surface of the stem where it is cut. Considerable benefits appear to have been gained by thoroughly drying the stem before packing so that it will be a less inviting field for spores. The Experiment Station has not yet been able to make a careful and exhaustive study of this subject. So far as observations have been carried, there is an advantage in allowing the fruit to stand on its crown for some time after gathering.

Second, innumerable vulnerable points are made by the bruising which takes place in shipping. Bruising of the fruit can be avoided by careful packing and handling. Third, it is probable that insects play their part in the spreading of this disease. Whether the pineapple mealy-bug, or the pineapple scale spreads this disease has not been proved, but the general nature of their attack makes it probable that they do. Mealy-bugs cluster at the base of the pineapple. They not only puncture the fruit but also cause it to crack open. The mealy-bug saps the vitality of the plant and mars the appearance of the fruit. The shipment of insect-infested fruits will also give Hawaiian pineapples a bad name in ports where careful quarantine regulations are enforced. Every effort should therefore be made to control insect pests in the pineapple fields. New fields should not be planted without carefully fumigating or dipping the plants to destroy the insects present.

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<sup>1</sup> Powell et al, U. S. Dept. of Agriculture, Bureau of Plant Industry, Bulletin No. 123.



## FRUIT FROM DIFFERENT FIELDS.

There appears to be a very wide difference in the keeping quality of pineapples from different fields. During the trials of two years the average loss on fruits from some fields has run as low as 4.93 per cent. while from other fields it has averaged



HAWAIIAN PINEAPPLES WITH STEMS CUT LONG.

25.77 per cent. While the evidence in hand is not conclusive it strongly suggests the importance of soil studies and fertilizer experiments in relation to the keeping quality of pineapples.

## LENGTH OF STEMS.

A large number of fruits were cut with stems two to three inches long and also others with stems one inch long or less.

The results are confirmatory of those of the year 1906, referred to in Bulletin No. 14. On fruits that showed a great tendency to decay in transit the part saved by cutting long stems averaged 17 per cent of the whole. The greater the tendency to decay, the greater became the saving on long-stemmed fruit. This 340 lbs. per ton or 17 per cent. would be worth \$17 on a basis of 5 cents per pound.

**BROKEN STEMS.** There is a point in the pineapple stalk where the fruit can be broken from the plant. This point, however, is too close to the fruit, even closer than it has been customary to cut. The difference in favor of long stems as compared with broken stems was over 46 per cent.

**PAPER WRAPPING.** In the experiments of 1906 it was shown that the use of a paper wrapping about each fruit resulted in a marked reduction in the loss. These results also are confirmed by the trials made in 1907. Where the loss was heavy without wrapping there was a saving on wrapped fruit ranging from  $4\frac{1}{4}$  per cent to over  $9\frac{1}{4}$  per cent. On an average this difference in favor of wrapping was about 6.6 per cent.

It is interesting to note that fruits that were cut with long stems and also wrapped in paper and otherwise comparable with the above showed an average saving of 22.37 per cent of the whole as compared with fruits cut with short stems and packed without paper. This approximates the figure obtained by adding the gains resulting from these two devices when practiced separately. This experiment confirms the results obtained in 1906.

## RELATIVE ADVANTAGE OF DIFFERENT PARTS OF SHIP.

During the experiments of 1907 tests were made of the relative advantages of the orlop deck and the after-deck for the carrying of pineapples. The 'tween-decks were not used at all since the results here the previous season were so decidedly unfavorable, and since this portion of the ship without a forced draft is manifestly without sufficient ventilation for carrying fruit. The temperatures are too high and the circulation of air is insufficient.

Pineapples from the three fields mentioned, were placed on the after-deck of the ship and were covered with a tarpaulin to protect them from the weather. The fruit on the orlop-deck was ventilated, as usual, by means of a windsail. The results show no constant advantage in favor of either of these decks. While in fair weather fruit can be carried on the after-deck with a fair degree of safety, in stormy or cold weather this cannot be done. The tarpaulin over the crates on the after-deck, should be placed a sufficient distance above the crates to permit a free circulation of air beneath. Otherwise the temperatures will become too high <sup>1</sup>

Carrying fruit where it is exposed to the vicissitudes of weather can be regarded only as a makeshift. Any steamship company which aims to get the fresh fruit trade must equip its ships to handle fruit in all weather.

#### REFRIGERATION VERSUS VENTILATION.

Some pineapples were shipped by the trade in refrigeration during the early part of the season of 1907. The temperature was to be held at about 50 degrees.

An experiment was made to determine the value of such refrigeration. In the case of pineapples from fields A and B, no advantage resulted, the loss being practically the same in refrigeration as on the after deck. No fruits from field C were shipped in refrigeration. The temperature of the refrigerated compartments was held at about 50 degrees F. after it had been reduced to this point. The compartments were very full, and it is probable that the temperature of the fruit remained for a long time above that of the air of the room. The temperature of 50 degrees F. was not attained in one of the largest compartments until about eight P. M. of July 26. 2½ days from the time of sailing. This temperature, 50 degrees, is higher than is used for the refrigeration of other fruits. While it would not be fair to conclude that refrigeration

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<sup>1</sup> See "Transportation by Sea," page 7.

is unsuited to pineapple shipments, it can be safely averred that an air temperature of 50 degrees attained two days or more after sailing, the fruit having been gathered several days preceding sailing, is of no particular advantage. A more effective refrigeration, which would bring the temperature of the compartment to perhaps 40 degrees within a short time after sailing, might give far different results. The cost of shipping by refrigeration is considerably greater than by ordinary freight. The lowest rates offered, so far as the writer is aware, for refrigerated freight from Honolulu to San Francisco is one cent per pound, about three times the cost for carrying on deck. If the simpler and cheaper method of transportation in ventilation should prove inefficient, it will then be necessary to conduct further experiments in refrigeration in transit using lower temperatures.

### BANANAS.

One of the experiments was the shipment of Chinese bananas to San Francisco unwrapped. This variety is always wrapped when exported from Hawaii. The wrapping consists of dried banana leaves or occasionally, dried grass; the latter however is not a suitable material.

A serious disadvantage, is that this wrapping gives to the bunch of bananas the appearance of greater protection than it really has. The fruit, therefore, receives very much rougher handling. The experiment was made for these reasons and because some have thought that the wrapping might be a direct cause of heating. Fifty bunches were shipped in connection with the first experiments of 1907. It was intended that these fruits should receive the same care on board ship as the rest of the cargo of wrapped fruit. Through an error the bunches were suspended from hooks and hung clear of each other. They thus received better care than the wrapped fruit. Notwithstanding this, these fifty bunches arrived in San Francisco in no better condition than those which were wrapped; and it was evident from their bruised condition that had they been placed with the others and been loaded and discharged in the same manner, they



would not have arrived in salable condition. The Chinese, or Cavendish variety, has a rind much more delicate than the so-called "Eastern" banana imported from Central America and the West Indies.

Since the bananas received unusually good care from the steamship company, the bruises were probably received from those who handled the fruit in Honolulu or in San Francisco. Both the consignor and the consignee should be slow to lay all the blame for losses at the door of the steamship company until they have made sure that none of it can be accounted for by their own methods of handling the fruit.

The so-called Eastern variety was introduced into Hawaii in 1904 under the name of "Bluefields" banana, Bluefields being an important port of shipment in the banana trade. It is well known that this variety is always shipped without wrapping both in steamships and by rail.

A great many offsets have been distributed throughout Hawaii from the stock introduced and propagated by this Station. Some of these fruits are beginning to appear, and a few bunches were shipped to San Francisco in November, 1907. One of these was overripe on arrival due to having been too near ripe when shipped. The others are reported to have arrived in most excellent condition and to have ripened with a bright color. This limited trial would not be a sufficient one upon which to base conclusions in the matter of shipping this variety without wrapping on the steamships from Honolulu, because these vessels are not specially equipped for the banana trade, as are those in the West Indian trade. It will not be long before a sufficient quantity of this fruit should be available to make a more extensive test.

If the Chinese, or Cavendish banana, continues in the Hawaiian trade, some methods of protection, preferable to those now in use, should be sought. On the mainland a cylindrical package known as a "banana drum," is coming into use in shipping bananas by express from the great central markets to the tributary territory. These are of heavy pasteboard or strawboard with three hoops and have a thin, wooden bottom. At the top,

a lining of heavy wrapping paper extends about a foot above the top of the drum. The bunch of bananas is packed within this drum and the paper tied about the stem, which thus makes a convenient handle for lifting the package. A similar drum is also being made with veneer sides in place of the pasteboard. These are quoted in Chicago at nine cents for a twelve inch drum, or ten cents for a fourteen inch drum; "knocked down" and crated for shipment. The paper drums cost about half this amount. It would be well to make a trial of these packages, as in case they should prove desirable, they could undoubtedly be manufactured here in Hawaii. Such packages would probably not receive as rough handling as the bunches wrapped in banana leaves.

### AVOCADOS.

The results set forth in Bulletin No. 14 regarding methods of picking, packing and shipment of avocados have been confirmed by the trials of 1907. Through an accident, many of the packages did not receive the treatment which had been planned, resulting in rather high percentages of loss. All that were packed and treated as described in Bulletin No. 14 gave satisfactory results.

The refrigeration given the avocados was the same as referred to above in the case of pineapples except that the temperature of 50 degrees F. was attained much more rapidly in the room where the avocados were placed. Although the fruit which was picked, packed and placed on board the steamer, as directed in Bulletin No. 14, arrived in San Francisco in good condition, it would have been better, judged by market standards, had it been firmer. The observations of this and other experiments, suggest that a temperature lower than 50 degrees is necessary for the most successful shipment of avocados. It is recommended, tentatively, that the temperature be held as low as 40 degrees.

Observing a few essential points in packing and shipping, the avocado appears not to be a difficult fruit to export. It is necessary to use care in picking and packing so as to avoid bruising. It seems hardly necessary to say that avocados which have been

shaken from the tree, or knocked off with sticks or stones, or allowed to fall, even after being cut, are unfit for shipment. Yet such fruit has repeatedly been shipped and has been in part responsible for the impression that avocados are an uncertain shipping fruit. To insure success the fruit, after careful picking, should be wrapped in paper and packed in single layer crates. *The spaces between the fruits should not be filled with paper*, as is often done. This paper makes refrigeration much more difficult, retaining the natural heat of the fruit until ripening has begun. Perhaps the most striking essential in shipping avocados is to get the fruit into refrigeration promptly after packing. It is characteristic of the avocado that it begins to soften very soon after picking. After this softening has begun, it is too late to arrest the ripening process and place the fruit on the market in a firm condition as required by the dealers. This fruit should arrive in the market perfectly hard. Fruit that is beginning to soften, even though it may be in prime condition for immediate use, will not sell readily. The dealers fear the risk of loss in case the fruit is not placed with consumers immediately.

The market for avocados is limited at present by reason of the high price, and in most inland cities this fruit is little known. Experience has gone far enough, however, to demonstrate that once the avocado becomes known and of moderate price, there will be markets for large quantities. First-class avocados in good condition sell in San Francisco for about \$2.50 per dozen, and there is little difficulty in disposing of all that arrive at the present time, provided only that they are firm and of good quality.

